Montana Department of Agriculture 2006 Pest Survey: Final Report
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Introduction

With the potential to destroy crops, nursery stock, and natural ecosystems, exotic plant pests pose a serious threat to Montana's natural and agricultural resources. Nationally, the U.S. Department of Agriculture (USDA) approximates that pest damage results in a $41 billion dollar annual loss. One way the USDA tries to mitigate annual losses caused by pest damage is through the Cooperative Agricultural Pest Survey (CAPS). The CAPS program seeks to detect and delineate plant pests of concern. The USDA's Animal and Plant Health Inspection Service (APHIS), Plant Protection & Quarantine (PPQ) works in cooperation with state departments of agriculture to carry out this mission.

As an intern with Montana Department of Agriculture's 2006 CAPS campaign, I conducted surveys for four pests: *Rhyacionia buoliana* (European pine shoot moth or EPSM), *Rhagoletis pomonella* (apple maggot fly or AM), *Agrilus planipennis* (emerald ash borer or EAB), and *Lymantria dispar* (gypsy moth or GM). Each pest has a unique history and impact, and thus the goals and methods for monitoring them differed.

The gypsy moth (see Figs. 1-3), a non-native insect introduced in 1869, has acquired a reputation in the eastern United as a devastating pest, defoliating as much as 12.9 million acres in a single year. Outbreaks frequently occur in the northeast and have occurred as far west as Utah and California. In high densities, GM larvae eat continuously, stripping a tree of nearly all foliage. Egg masses and larvae may be transported by cars or recreational vehicles. When these larvae become adults later in the season, they may breed and lead to an infestation the following year, provided the eggs survive the winter. GM prefers hardwood, but during times of dense population they also feed on *Pinus* and *Tsuga* species.



Figs. 1-3: Gypsy moth larvae emerging from egg mass, an older larva, and a male adult gypsy moth. Taken from Forest Insect and Disease Leaflet 161.

European pine shoot moth (see Fig. 4), another non-native whose origins in North America date back to 1914, has much in common with GM . Infestations are most common in the northeastern U.S. and southeastern Canada but have also occurred in Washington State, Oregon, Idaho, and British Columbia. Historically, EPSM has moved through infested ornamental nursery stock. Larval infestations can limit growth of trees or lead to deformations such as trunk forking. Given the abundance of *Pinus ponderosa* and *Pinus contorta* in Montana and the value of these trees for lumber or non-extractive uses, the reasons for trapping EPSM are clear.

Fig. 4: EPSM adult. Taken from http://www.acgov.org/cda/awm/agprograms/images/pineshootlarge.jpg.

Emerald ash borer (see Figs. 5 and 6) is a more recent pest problem. Since its discovery in Michigan in 2002, EAB has spread to Ohio, Indiana, and Ontario, killing 20 million ash trees and causing a regulatory quarantine to prevent EAB movement in the three U.S. states. Highly selective eaters, EAB larvae invade the inner bark of ash trees and inhibit water and nutrient translocation. The goals of Montana's EAB survey were to get a general idea of the quantity of ash trees throughout the state and to search for telltale signs of EAB infestations.

Figs. 5 and 6: Ash borer larva and adult. Taken from http://www.emeraldashborer.info.

Apple maggot (see Fig. 7), unlike the other three pests, is native to the U.S. It is distributed from Oklahoma to North Dakota and eastward. As its name indicates, AM use apple trees as a host, but they also feed on a variety of other fruits, including *Cretaegus*, a shrub native to Montana. Females lay their eggs beneath the skin of fruits. Larvae emerge to feed on the fruit; then, when the fruit drops, larvae transform into pupae and burrow into the soil to overwinter.

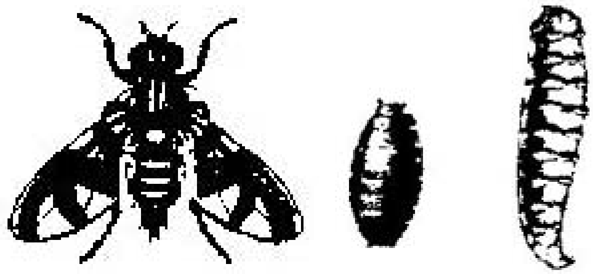

Fig. 7: AM fly, puparium, and larva. Taken from http://ohioline.osu.edu/hyg-fact/2000/2041.html.

Methods

The gypsy moth survey involved placing 250 traps in quadrants lying west of the continental divide (see accompanying map). APHIS conducted GM surveys in quadrants lying east of the divide, and the Montana DNRC conducted surveys in portions of counties in western Montana. Some traps were placed east of the divide, such as those in the Big Hole Valley, because portions of their respective quadrants lie west of the divide.

A pheromone strip that attracts adult male gypsy moths was stapled to each trap. Gypsy moth traps, like the EPSM and AM traps to follow, were lined with tanglefoot.

GM trap placement had two primary goals: 1) to place the traps approximately four miles apart near major highways, and 2) to place the traps in deciduous trees or shrubs, the preferred hosts of gypsy moths. Both of these goals could not be reached at all times, e.g., the Big Hole Valley had lower trap densities than one per four miles because of a lack of potential hosts.

In descending order of frequency, the following deciduous plant genera were selected as trap sites: *Populus*, *Salix*, *Acer*, *Betula*, *Alnus*, *Prunus*, *Rosa*, *Cornus*, and *Physocarpus*. When there were no deciduous trees or shrubs available for placement, *Pinus* and *Tsuga* were selected.

GM traps were checked five times. Trap checking occurred continually June through August. Suspects were sent by overnight delivery to the state offices in Helena for verification. Upon completion of the survey, all traps were re-inspected by the State Entomologist.

The European pine shoot moth survey called for 80 traps in western Montana, the majority of which, at the direction of the State Survey Coordinator and the State Entomologist, were to be placed in Sanders County. In the end, more than 50% of EPSM traps were placed in Sanders County (see accompanying map). The remaining traps were placed at sites rich in *Pinus*.

A pheromone strip that attracts EPSM male adults was placed in the tanglefoot of the trap. EPSM traps were checked and pulled for re-examination by the state entomologist three times, beginning in late June and ending in mid-August.

Twenty apple maggot traps were placed throughout Lawyer nursery, wherever an apple tree or *Cretaegus* could be found on or near nursery operations. These traps were placed in early July and changed and sent to the state offices in mid-July. The second group of traps was sent to the state offices in early August.

The goal of the AM survey was to ensure that the stock of Lawyer Nursery, the state's largest, was free of the pest. Although Lawyer Nursery sells little or no fruit producing apple trees in Montana, it does sell *Cretaegus*, and numerous fruiting apple trees lie on or near the nursery property.

The emerald ash borer survey was unique in several respects. It called for a large number of trees, preferably 100, to be inspected at a site for D-shaped exit holes, a tell-tale sign of EAB. Additionally, trees at each site were categorized into basic categories, e.g., ash, elm, poplar, or conifer. This information could help in defining areas that would be most damaged by an EAB infestation. In all, eight EAB surveys were completed, using parks and residential areas for sites.

Results

There were no positive findings of GM.

One EPSM was found at a site in urban Kalispell. This positive finding occurred during examination of EPSM traps by the state entomologist, further stressing the importance of the reexaminations of the last traps prior to reaching any final conclusions about EPSM or gypsy moth.

All AM traps were examined and found to contain no AM.

No EAB D-shaped exit holes were found, and few or no ash trees were found at sites.

Conclusions

Perhaps the most important conclusion to be reached is that all the hard work by the people who monitor and control pest populations is paying off. In regards to the one positive EPSM find, it appears to be an isolated incident because another trap close in proximity contained no EPSM. It does however seem prudent to trap urban Kalispell at higher densities next year to ascertain if any EPSM survived the winter.

The rest of my conclusions are less formal and can be divided into two categories: 1) practical pieces of advice I would like to hand down to my successor, and 2) things I learned during my CAPS internship that go beyond the pests.

This would be my list of advice to future CAPS interns, all of which I had to learn the hard way:

- Take your time in placing the traps, in spite of your desire to get them out as soon as possible. Inevitably, a good site appears a quarter mile after the bad site where you just placed the trap. Traps should be placed at a spot in the road that can be accessed easily going either way. There should be good visibility of both lanes of traffic. In short, highways are dangerous. Consider your own safety.
- Stay organized and stay on top of the paperwork. This will save you a lot of time.
- Put time into learning the insects. I just looked at a dozen pictures or so of each insect on the internet and thought this would suffice. It did not.
- Eschew shortcuts, in terms of roads. My "shortcuts" almost always cost me more time than they were worth. And despite what your Montana highway map tells you, that paved road may turn out to be thirty miles of dirt and boulders.

- Try not to drive the stretches of road between Seeley Lake and Swan Lake or Thompson Falls and Noxon at dawn or dusk. I found these to be the two worst roads for deer. Of course, in western Montana, that is a relative statement.
- Plan your route so that you are not driving East to West at dusk so the sun does not get in your eyes.
- If you wear a polyester shirt, you will not be shocked by static electricity every four miles when you get out of the car. I wore cotton all summer, and I am still gun shy about touching car doors.

As far as CAPS beyond pests goes, I truly loved this job. People drive and fly thousands of miles to take in the scenery that I got paid to drive through every day. Here is some of what I saw. I saw the great diversity that exists among insects. I saw a geologist's dream: roadcuts, roadcuts, and more roadcuts. I saw dozens of osprey, dozens of bighorn sheep, dozens of turkeys, an elk, two moose, two bull snakes, a red fox, a coyote, and a turtle. I saw red-tailed hawks hunting chipmunks in the Big Hole. I saw a sparrow or some other small bird wriggle itself out of the grasp of a raptor. I almost stepped on a skunk near Kalispell.

There is something to be said for driving through the same areas as the summer cycles on, too. I saw rivers that bulged over their banks in June shrivel up in July and August. I saw all of western Montana dry up and some of it catch fire. I saw the changes in flowering vegetation, as the chokecherries gave way to the herbaceous plants which yielded to the ninebark. Not everything I saw was so pleasant. I saw enough roadside trash and knapweed to get depressed by them and wonder if either one of them could ever be controlled.

Those concerns aside, the internship was like a three month course in natural history. Add to that the flexibility in scheduling that allowed me to keep an infant daughter out of daycare, and I simply cannot express enough gratitude to the Montana Department of Agriculture and my supervisors for the opportunity to participate in the CAPS program.

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Surveys of *Phytophthora ramorum,* cereal leaf beetle, and Karnal bunt

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Going into this summer internship, I was not really sure what to expect. I was not familiar with any of the pests (*Phytophthora ramorum,* cereal leaf beetle, or Karnal bunt). For the *P. ramorum* survey I expected to find more plant material at the nurseries that would be hosts. I was surprised by how few of the nurseries carried Douglas fir and viburnum, while plants such as roses and lilacs were abundant. I also did not expect to be confronted with opposition from nursery owners. Even when I tried to explain why I was there, some nursery owners felt that they were being singled out and felt that the survey made their nursery appear like it might have a disease. Overall, I felt this was a good experience since at most of the nurseries I was able to complete the duties and most of the people were cooperative.

At some of the locations there were few samples of Rhododendron, lilac, Douglas fir, and viburnum available. Therefore, it was not feasible to collect forty samples from every nursery. At a few locations there was opposition to the survey since nursery owners and managers were unsure of why they were chosen to be tested. Nursery owners and managers were also worried that customers would see the gloves and disinfectant, and would think there was something wrong with their nursery. Thus, it became apparent that it was important to state what the survey involved to the manager immediately upon arrival and that it was voluntary. Nursery owners and managers also wondered when they would be hearing the results and whether they would be receiving a certification if their nursery was free from *P. ramorum.*

Phytophthora ramorum survey:

Phytophthora ramorum is the causal agent for a disease known as Sudden Oak Death (SOD) or *P. ramorum* blight. This agent is a fungus and is of concern in North America and Europe for three reasons: 1.) high level of local destruction, 2.) lack of knowledge of its epidemiology, and 3.) its high prevalence in nurseries. This disease affects numerous species including oak, Rhododendron, roses, Douglas fir, lilacs, and viburnum. Sudden Oak Death has been known to occur in coastal areas of California since 1995, causing widespread dieback of tanoak and several oak species (coast live oak, California black oak, Shreve's oak, and canyon live oak) in California's central and northern coastal counties. *P. ramorum* has been found in nurseries in at least twelve continental European countries, in Washington State, in British Columbia, and in Oregon State. How *P. ramorum* originally entered Europe and the United States is unknown.

Fungal spores are spread to new locations mainly by the nursery trade and are spread locally by vectors, soil, water, tools, and articles associated with humans. California nurseries sent potentially infected plant material to all 50 states, with Montana receiving a number of shipments from one or more of the confirmed positive nurseries.

There are two categories of hosts, each of which are susceptible to the pathogen in different plant parts: bark canker hosts and foliar hosts. Bark canker hosts become infected on their trunks. Mortality may occur in as little as two years. Foliar hosts become infected on their leaves and twigs. They only occasionally die from the infection (http://www.invasivespecies.net/database/ species/ecology.asp?si=5638&fr=18sts=sss). Thus foliar hosts, such as California bay laurel and Rhododendron species, do not die from the disease, but they do play a key role in the spread of *P. ramorum*, acting as hosts for inoculum, which may then spread (California Oak Mortality Task Force, http://nature.berkeley.edu/comtf/html/ about_p_ramorum.html). There is no known treatment for *P. ramorum*, so elimination of the infected host materials is the only method to control the pathogen.

According to the Global Invasive Species Database, *P. ramorum* spreads aerially and generally infests trees and plants above the soil line (including leaves, shoots, woody stems, and bark). Fungal infections on the bark develop into cankers, which produce red/brown/black sappy exudates (bleeding). Cankers can occur on the trunk from the root crown up to 20 m above the ground, but do not occur below the soil line in the roots. Aerial seeps not connected to the root collar are a good indication that a tree is infected. When the outer bark is removed, mottled areas of necrotic (dead and dying) and discolored inner-bark tissue with black “zone lines” around the edges may be seen. When cankers girdle the trunk, death of the tree occurs resulting in a rapid change in the color of the foliage. Fungal infections on the leaves cause spotting and browning, often at the edge or tip of the leaf. Infections on the twigs cause branch drooping and dieback. On conifers, the pathogen causes needle blight and dieback of young shoots of Douglas fir, coastal redwood, and grand fir. On yews, symptoms are a needle blight of the young foliage resulting in an aerial dieback.The optimal growth temperature for *P. ramorum* is 20ºC. It grows best in areas with wet climates and constant mild temperatures, resembling the central California coast (Global Invasive Species Database, http://www.invasivespecies.net/database/species/ ecology.asp?si=5638&fr=18sts=sss and Department for Environment, Food, and Rural Affairs, http://www.defra.gov.uk/planth/ pestnote/newram.pdf).

The objective of the 2006 *P. ramorum* National Nursery Survey was to determine the distribution of *P. ramorum* in the nursery system in the United States. The statewide survey was important so that Montana can continue to certify that nursery stock for export is free from *P. ramorum.* The survey also contributed to identifying potential infestations and provided the basis for further delimitation, control measures, and regulatory action. The survey consisted of collecting a total of 600 samples according to USDA APHIS PPQ protocols from fourteen nurseries in the following cities: Hamilton, Missoula, Great Falls, Helena, Corvallis, Plains, Polson, Bozeman, Billings, Kalispell, Big Timber, and Miles City. Cities that were expected to be surveyed but were not because of logistics and time restraints were Wolf Point, Glasgow, and Terry. Samples were shipped to the Montana State University Plant Diagnostic Laboratory for testing. All of the samples submitted came back negative for *P. ramorum*.

In the future, I would call the nursery ahead of time to ask their permission and explain what the procedure would involve. More samples could be taken from nurseries that contain more host species, especially wholesale nurseries, and fewer from nurseries with fewer host species.

Cereal Leaf Beetle survey:

For the cereal leaf beetle (CLB) survey, I expected grain to be easier to find in some of the counties, such as Rosebud, Carbon, Phillips, and Petroleum counties. The survey required finding grain fields throughout the county, which was difficult when the grain was clustered in one area. In other counties, however, there were abundant grain fields to take samples from, especially up on the northern hi-line of Montana. Later in the survey it was hard to find grain that had not flowered, so not as many fields were able to be sampled as earlier in the survey.

The cereal leaf beetle, *Oulema melanopus*, is a defoliating pest of small grains, including malting barley, oats, and wheat. It has been present in Montana for over a decade, and has spread to all but a handful of counties on the northern Hi-Line of Montana. This survey was important to observe the natural expansion of the range of CLB and to delimit its range in Montana for regulatory purposes. Feeding by CLB reduces the yield of crops and increases the cost of production through the use of pesticide application to standing crops and the costs of compliance with various quarantines. The survey determines the current range of CLB in Montana, which benefits Montana grain and hay producers.

According to the Montana State University Extension Service, CLB was first detected in Michigan in 1962, Utah in 1984, and Montana in 1989. In Montana it was first found in Yellowstone County, and the following year it was detected in Yellowstone, Stillwater, and Carbon counties.

Both the adults and larvae of cereal leaf beetle damage grain crops through their foliar feeding. The adult beetles are 3/16 inch long. They are very active during the cooler parts of the day and evenings, but may disappear during the heat of the day. They overwinter as adults in field edges and standing grass, moving into grain fields and feeding on small grain and grass foliage after they become active in the spring. They prefer spring grains over winter grains and barley and oats over wheat. The adults chew completely through the leaf, between the veins, resulting in a linear streaking of the leaf. Eggs hatch in four to 23 days, depending on the temperature. The larvae have a yellow body with brown head and legs. The body is protected by a layer of slimy fecal material, which makes them look like a slug. The larvae feed on the leaf surface between veins, removing all the green material down to the cuticle resulting in an elongated windowpane in the leaf. Severe feeding damage can give a frosted appearance to the field. Larval feeding differs from adult damage in that it is wider and limited to the upper surface of the leaf (http://www.ext.colostate.edu/pubs/insect/05596.html).

When the larvae have completed their feeding, they shed their slimy covering and drop to the ground, hollowing out an earthen cell for pupation. The pupal stage takes 10 to 14 days to complete. When new adults emerge from pupation, they feed briefly on grasses, before leaving the field and finding a protected overwintering site. The larvae are the most damaging stage and the target of control measures. The boot stage (one larva per flag leaf) is a critical point in plant development and impact of cereal leaf beetle feeding damage can be felt on both yield and grain quality. Once the flag leaf emerges, feeding is generally restricted to the flag leaf, which can significantly impact grain yield and quality (http://scarab.msu.montana.edu/ipm/clb.html#A3).

Montana's wheat industry is a valuable component of Montana agriculture. Montana ranks fourth in the nation for wheat production; in 2004 over 173 million bushels of wheat were produced. Wheat and wheat products are Montana's leading exports, making up 78% of the state's agricultural exports. Cereal leaf beetle not only impacts the standing crop, but also has an impact on exports due to quarantines and required treatments. Thus, a detrimental pest such as cereal leaf beetle affects the exportation of Montana grain, especially to California and Canada, which have regulatory controls. This survey allows the state to analyze the expansion of cereal leaf beetle and determine the impact of introducing parasitoids as a biological control measure.

The USDA has introduced several parasitoids in an effort to reduce the costs of cereal leaf beetle to producers. Two parasitoids have been introduced in Montana, *Tetrastichus julis* and *Anaphes flavipes*. The parasitic wasp *T. julis* attacks the larval CLB reducing survival and undergoes range expansion almost simultaneously with the beetle. It has one to two generations per year. An average of five *T. julis* have been found in a single cereal leaf beetle larvae (http://scarab.msu.montana.edu/ipm/clb.html#A3). According to the Colorado State University Cooperative Extension, the success of the biological control varies with cropping systems, with greater success in dry land systems than in irrigated systems (http://www.ext.colostate.edu/pubs/insect/05596.html). The parasitoid *T. julis* was found in Carbon, Cascade, Big Horn, Flathead, Lake, and Gallatin counties. This survey provided information on the natural expansion and success of artificial introductions of the parasitoids. Thus the survey inspected for adult, larvae, and eggs of cereal leaf beetle, as well as the parasitoid *T. julis* within the larvae.

In 2004, *T. julis* was released in Toole, Jefferson, Meagher, and Richland counties. It was recovered in 2004 from Toole, Jefferson, and Meagher counties. For the 2006 survey, however, *T. julis* was not recovered in any of these counties, while all of the counties were surveyed for the parasitoid. The counties surveyed in the 2006 census that contained the parasitoid *T. julis* were in the south (Big Horn, Carbon, and Gallatin Counties), center (Cascade County), and northwest (Lake and Flathead Counties).

Surveys were conducted on malt barley, oats, spring wheat, and winter wheat crops. At least five fields in each county were surveyed, with two sub-samples of 50 sweeps each, per field. A GPS point was marked at each field to record where sites had been sampled. The survey methods were conducted in accordance with the established protocols used by the Montana Department of Agriculture.

A total of 36 counties were surveyed for CLB. I surveyed 27 of these counties. The following counties were surveyed for cereal leaf beetle and biological control by all of the interns in the Montana Department of Agriculture Pest Management Section: Glacier, Toole, Pondera, Liberty, Hill, Chouteau, Blaine, Phillips, Valley, Daniels, Sheridan, Roosevelt, Lewis & Clark, Richland, Wibaux, Fallon, Rosebud, Big Horn, Yellowstone, Carbon, Wheatland, Broadwater, Madison, Gallatin, Treasure, Flathead, Lake, Missoula, Jefferson, Gallatin, Meagher, Cascade, Teton, Judith Basin, Fergus, and Petroleum.

A majority of the farms producing cereal grains in Montana are located in the northern portion of the state, along the Hi-Line. However, a majority of the positive samples were taken in the southern part of the state.

Cereal leaf beetle prefers younger plants. Therefore, sampling was done in fields that contained earlier stages of grain. This determined not only which fields were sampled, but also where sampling was initiated.

Cereal leaf beetle adults were found in Teton, Carbon, Wibaux, Lewis & Clark, Broadwater, Big Horn, Yellowstone, Treasure, Cascade, Flathead, Lake, and Missoula counties. Small larvae were found in Carbon, Big Horn, Flathead, and Lake Counties, while large larvae were found in Carbon, Big Horn, Treasure, Flathead, Lake, and Gallatin counties. Eggs were harder to find, being only in Wibaux and Big Horn counties.

The counties in the south east part of the state were surveyed first during the end of May. These counties included Rosebud, Big Horn, Treasure, and Yellowstone counties. Wheatland, Yellowstone, and Carbon were surveyed during the last week of May and first week of June. During this time the grain was still young and just entering the jointing stage. It had not started to flower yet. During the middle of June the following counties were surveyed: Chouteau, Liberty, Hill, Phillips, Fergus, Teton, Blaine, Roosevelt, Sheridan, Daniels, Valley, Richland, Wibaux, and Fallon counties. At this point the grain was starting to flower and ripen. Cereal leaf beetle prefers grain that has not yet flowered and is still in the younger stages. Therefore, grain was sought that had not yet flowered.

During the last week of June the following counties were surveyed: Pondera, Glacier, Toole, Liberty, Hill, and Blaine. During the first week of July, which was the last week of the survey, the following counties were surveyed: Cascade, Judith Basin, Fergus, Petroleum, Wheatland, and Meagher. Young grain was sought after, but it was difficult to find five young grain fields in each county.

Figure 1. This picture shows the damage caused by cereal leaf beetle feeding in Carbon County.

The counties on the northern hi-line had more wind than the counties in the southern regions, where more cereal leaf beetle was found. The wind could possibly be a deterrent to cereal leaf beetle establishments in areas such as Daniels, Valley, Roosevelt, Sheridan, Judith Basin, and Petroleum counties.

Karnal bunt survey:

Going into the Karnal bunt survey, I did not expect to find any Karnal bunt because it has never been found in Montana ever since the survey began in 1996. I also think the survey will require good record-keeping since there is a designated amount of samples that must be taken from each county.

Karnal bunt (KB) is a fungal disease of wheat and triticale caused by the fungus *Tilletia indica*. The disease was discovered in 1931 in northern India. The first discovery of KB in the U.S. was in Arizona in March 1996. It is currently only found in three states: California, Arizona, and Texas. According to the USDA Animal and Plant Health Inspection Service (APHIS), KB can cause significant reductions in seed weight and viability if seed is severely infected. However, the main effect of KB is to impart a fishy odor and taste to wheat flour. Karnal bunt is spread mainly by the planting of infected seeds. Ideal conditions for the development of the fungus are cool weather, rainfall, and high humidity at the time of heading.

Karnal bunt is spread through spores that can live in the soil five years or more. The mechanical action of harvesting causes infected grains to rupture, liberating the resting spores (teliospores) of the fungus from the infected grains. Compared to other bunt species, KB is difficult to control. Chemical seed treatments used on other bunt species cannot be used on KB because there is insufficient chemical in the plant at heading when infection occurs. There are no known biological controls at this time (http://www.defra.gov.uk/planth/pestnote/karnal.pdf).

Montana has participated in this survey since 1996, in which time Montana has never been found to have KB. It is considered a priority pest nationwide and is identified on the CAPS Western Region Pest List. According to the Invasive species and Pest Management of the USDA, APHIS, PPQ, the sole purpose of the national survey is to provide U.S. certifying officials the ability to issue phytosanitary certificates required by any and all countries to which we export (or may export) wheat. Participation in the survey enables Montana and U.S. officials to continue to certify that wheat entering export markets originates where Karnal bunt is not known to occur. This survey will also assist in detecting potential infestations and provide the basis for further delimitation and control measures if infestations are found.

The minimum sampling requirement is one 4-pound sample from a selected county with 1,000,000 bushels of production. Each 4-pound sample represents approximately 1,000,000 bushels of host crop. The sample consisted entirely of one species and each sample contained grain from a single county. Sample distribution is proportionate to each county's contribution to Montana's total wheat production according to statistics provided by USDA National Agricultural Statistics Service. The sample collection takes place at the Montana Department of

Agriculture State Grain Laboratory located in Great Falls, Montana. The samples were submitted to Olney, Texas to be analyzed using an optical sorter. All survey data was entered into the NAPIS database.

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USDA Survey Manual for P. ramorum

National Karnal Bunt Survey of Wheat Grain handbook prepared by the Invasive Species and Pest Management (USDA, APHIS, PPQ)

Survey of Exotic Wood Boring Insects
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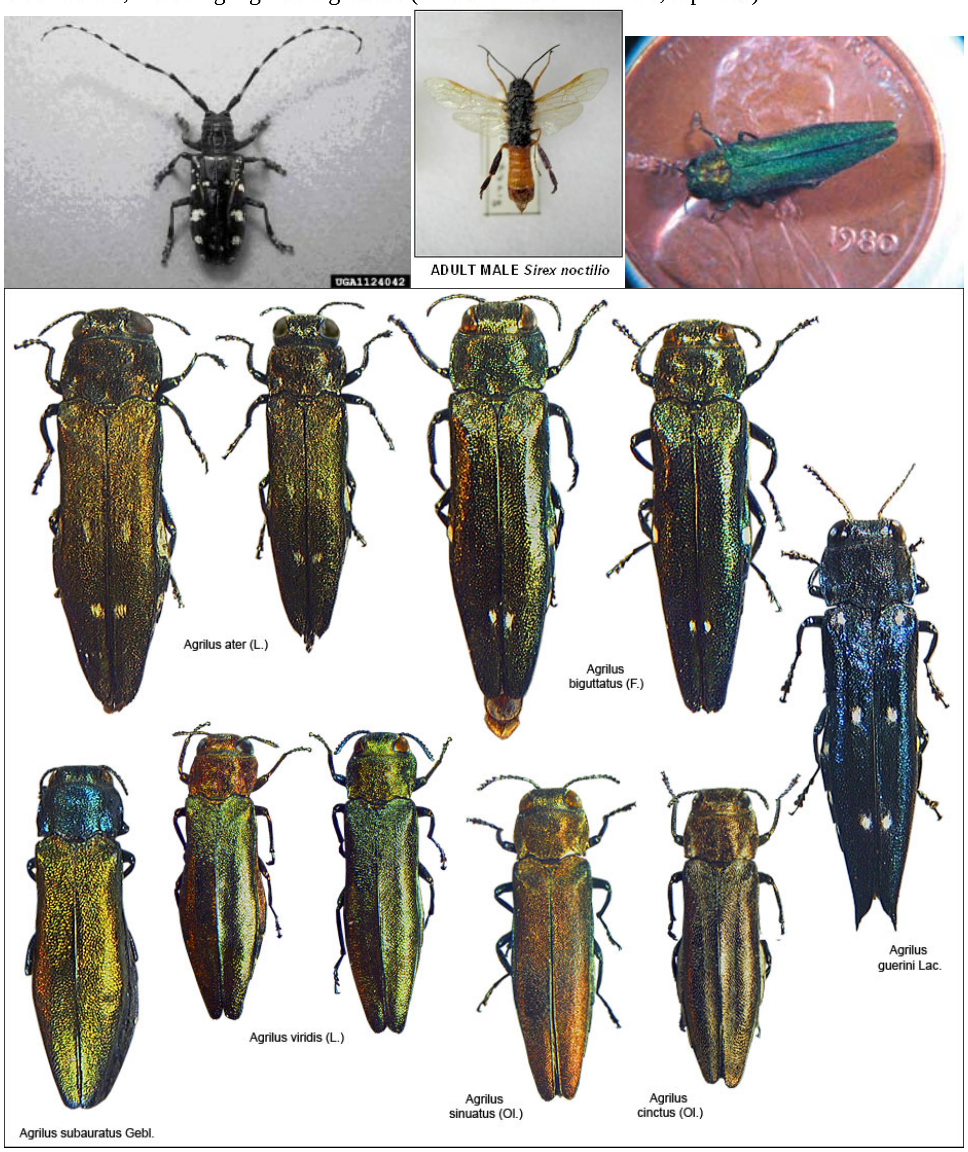
Summer 2006

This survey was conducted to help determine the presence of four non-native wood boring species of insects in Montana. These insects are the Emerald Ash Borer (*Agrilius planipennis*), European Wood Wasp (*Sirex noctilio*), Asian Long Horned Beetle (*Anoplophora glabripennis*), and Metallic Beetle (*Agrilus biguttatus*) (Figure 1). Early detection of a non native wood boring species, would aid in implementing early eradication procedures, and would provide warning for surrounding areas.

Figure 1. From left to right, Asian Longhorned beetle, male European wood wasp, Emerald ash borer. Below, assorted metallic wood borers, including Agrilus biguttatus (third and fourth from left, top row.)



The Emerald Ash Borer was first discovered near Detriot, Michigan in 2002. It has since been found in Ohio, Indiana, New Jersey, Maryland and Ontario. The Asian Longhorned Beetle found its way to Brooklyn in 1996 on a crate shipped in from China. It has since been found in New York, New Jersey, Chicago, and Toronto. The Japanese Beetle, (metallic colored beetle) "was accidentally introduced to a nursery in Riverton, NJ in 1916. It's likely that the beetle larvae (white grubs) arrived in the soil ball of nursery stock. The beetle is currently present in all states east of the Mississippi River except Florida" (Held).

It is important for us to be aware of wood boring insects in our state early on, for the sake of Montana's tree population and economic impacts these insects incur. The non-native wood borers lay their eggs in trees, which causes branches to die off and eventually brings death to the entire tree. Ways these insects are spread are through contaminated wood made into crates and other shipping products. This is the reason for placing traps in industrial areas.

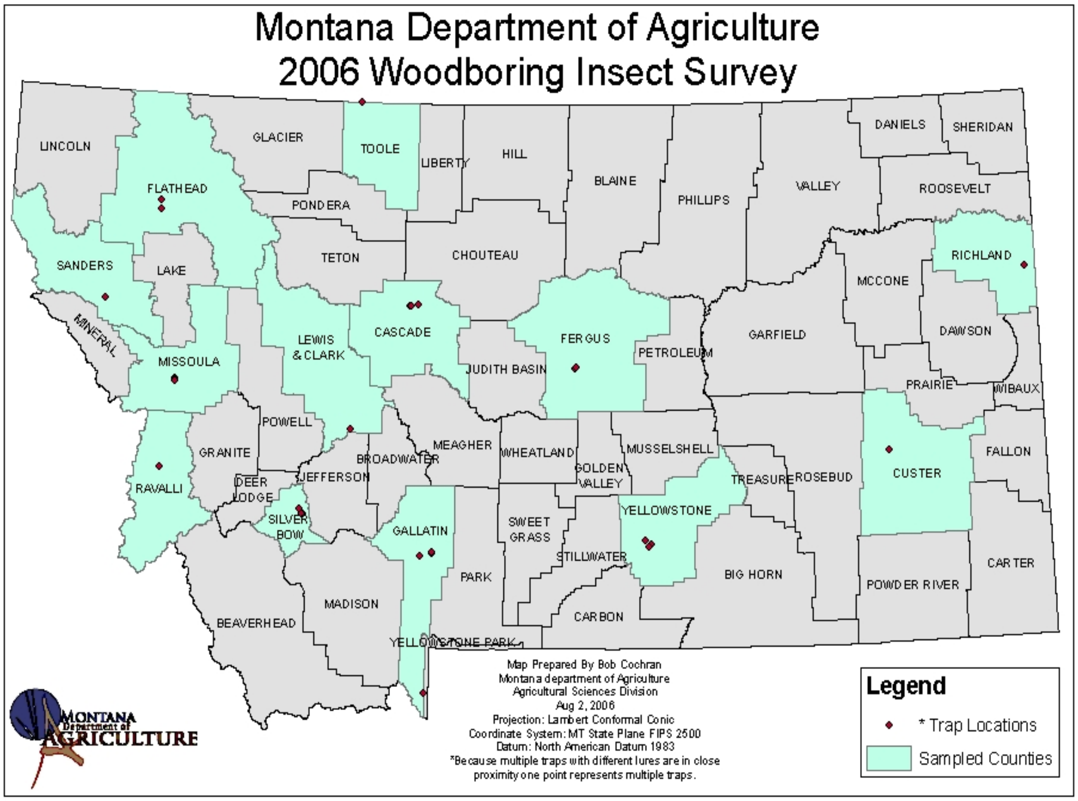
Lindgren funnel traps (Figure 2) were used for collecting insects in thirteen cities across Montana from May until August. The traps were baited with substances such as ethanol and pheromones. A diluted marine antifreeze and water mix sat in the cup at the bottom of the trap. Suspect bugs are attracted to the trap and fall down a series of funnels into the cup; waiting to be collected. All traps were marked with a GPS unit for future reference, should any questionable bugs be found. A questionnaire sheet was also filled out when the traps were initially set up noting location, GPS, surrounding wood products and similar information.

Figure 2. Lindgren funnel trap similar to those used in the exotic woodboring beetle survey in Montana.

LINDGREN FUNNELTRAP
FOR *Sirex noctilio*

A rotation was made around Montana to collect the insects with cups being emptied and refilled with antifreeze every two weeks. The samples were run back to Helena generally a few times a week. Traps were set up in sets of three; using three different attracting fluids.

Figure 3. Map showing location of traps and counties sampled in Montana during the exotic wood boring beetle survey.



Locations were usually industrial businesses with yards where the traps could hang on the fence. Locations were typically chosen based on areas that carried potentially contaminated wood supply, or at risk trees. The Montana cities were: Miles City with 3 traps, Billings with 9 traps, Sidney with 6 traps, Lewistown with 6 traps, Bozeman with 9 traps, Kalispell with 9 traps, Missoula with 9 traps, Plains with 3 traps, Sweet Grass with 3 traps, Great Falls with 9 traps, Helena with 3 traps, Butte with 6 traps and West Yellowstone with 3 traps.

Fortunately, none of the target insects were found in Montana, although a rare giant lacewing was located in a Great Falls trap.

This summer's job was very educational for me. I appreciate having a job where I am learning new things and am out in the field, rather than sitting at a desk all day. This study has heightened my attention to knowing about Montana's invasive species, and has prepared me to share this information with others. The most exciting moment was in Sidney, Montana where I found a giant dung beetle in one of the traps. It was surely the bug highlight of the summer! I thoroughly enjoyed traveling nearly 20,000 miles across Montana during this summer. It let me appreciate Montana's beauty, and gave me many hours to reflect on many things. I love working for the Montana Department of Agriculture and hope to come back for the summer of 2007!

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